QUESTIONS FOR MY FATHER ABOUT CLIMATE CHANGE

Ralph Chapman — The theme of distance to me suggests, immediately in relation to climate change, what economists call externalities, or spillover effects, in time and place. To translate that into everyday language, many of our actions and our transactions, whatever we do, create carbon emissions, which create a problem for someone else in a different place, somewhere distant from us, or in the future. In effect what we're doing by burning fossil fuels is creating a problem for someone distant in one of two senses and sometimes both.

> Amy Howden-Chapman — The fundamental problem that links climate change and the way we think about it is distance. Is that helpful?

RC — Yes, distance between our acts and their consequences. You asked about practising thinking about distance and the way we usually do that is we find social practices, social conventions or ways of thinking, that draw our attention to

problems of distance, and make us empathise even more with the future, with future generations, or people in distant places. That's always hard because in a sense what you're asking people to do is empathise over space and time and humans aren't very good at that. They're good at facing the problems here and now, they're not good at facing the distant future and distant problems. Yet, the failure to deal with that distance is what is now threatening human civilization. New Scientist's headline this week was "Arctic Meltdown: Earth faces its biggest change in 3 million years." Another scientist is quoted as saying, "The changes underway in the Arctic are the most significant, in scale and rate, that we have seen in the history of civilization." There's a bit of paleo-historical distance on the problem.

It's a fundamental point in psychology as well as in economics, that people need incentives (motivation) and information to try and deal with those problems. So the typical economic incentives are to try and put a price on something, or regulate an activity that forces people to think about other people. So, for example,

traffic lights force people to think about other people in cars. Traffic signals force drivers to think about other people on the road, and regulate conduct in that sense, and in psychology there are all sorts of insights about how you can train people to think about other people and the wider community.

We're good at thinking about our immediate community, or family, perhaps our local community, but we're pretty hopeless in thinking about the national community, or the international community. So a lot of psychology is about encouraging norms, or morality, ways of contemplating other people, other places. And climate change really brings those moral/ethical issues into immediate relief because you don't have much time to deal with those. So while we're trying to solve issues of inequality and so on we're faced with this time-short problem of climate change where we have a very limited window – and it's steadily closing – to do anything about it. We're facing fundamental problems of human nature, and human empathy, while the clock is ticking, and that's not a very nice com-

bination because they're hard enough to deal with anyway, let alone under time pressure.

> AHC — In terms of what's involved in changing minds and behaviors, in reducing the sense of distance between people, how much does information help?

RC — Information, and by this I mean all sorts of information such as scientific knowledge, can only help so much. Gathering more relevant information is sometimes persuasive in bringing more people into the fold: for example, providing more information about the effects of your own actions on other people. But it's remarkable actually how providing more information doesn't dent some people's perceptions. There's a theory in psychology called information deficit theory. It's the (apparently obvious) proposition that if you give people the right information, that information will change their behaviour. But the insight of work around information deficit theory is that while information works to some extent, in practice it doesn't work to a large

extent for many people, so essentially - and this pervades economics too - if you just give people information it won't solve the problem. So if you provide information about climate change, many people will essentially shrug it off. You can provide all the information you want but if that information is not consistent with the sort of daily experience people have, or their personal predilections, or mental frames, they will rationalize away that information. They either won't hear that information or they will distort it in some way, and that's closely connected with denial, of course. That's one problem with information.

In general, economists think both information and incentives are necessary to support change, but I suppose economists like myself think that incentives are more important, partly because of people's tendency to overlook inconvenient information. But then economists come up against the problem that people don't necessarily want to feel persuaded or coerced by strong incentives, and they will resist the introduction of strong incentives through political means. A classic incentive that economists suggest in

many policy areas is a price incentive, but it's very difficult to get human communities to agree on big price incentives, big penalties on certain actions.

So what we see, in the climate context for example, is resistance to a carbon price. A price on carbon emissions is the incentive recommended by many economists as a way of tackling the climate change problem, but the reality is that the price signal should be a very strong price signal if it's going to solve the climate mitigation problem in time. But the political workings of society are such that people won't accept a high price. Not only do people in some cases resist the whole notion that climate change needs to be solved quickly, but they resist the solution, which is a high price on carbon, and they in fact move heaven and earth to avoid the introduction of laws that mandate a high price on carbon. And yet for many people, according to their own market-based beliefs, price incentives are efficient and effective. So on the one hand people say yes, people should face a price for polluting, but on the other hand they say we shouldn't

have a high price which, in the case of climate change, may be the only thing that would work to cut emissions rapidly and efficiently. So we face a dilemma – in terms of economic theory, incentives are known to be very strong in changing behaviour, but nevertheless in practice they have to be mediated through a political economy, and it turns out to be nigh impossible to introduce a strong price signal in a democracy. Essentially, too many people in some democracies such as the US don't want it to happen, and they articulate concerns about the price incentive and it doesn't get over the line. Or where it does, it is set way too low to make a difference. That's more or less where we are now in New Zealand and California, to take just two jurisdictions.

AHC — Is there a strong price incentive in China?

RC — No. There are currently no price incentives in China working against carbon emissions, although they are about to introduce some in seven provinces. It's not that the Chinese don't believe prices work. They probably do believe

that prices work, because they're traders, they've got an active economy going now, since 1978 – a market economy. But they are generally loathe to intervene in that market economy because they're tending to suffer the same delusions about the market economy that many in the West are suffering from – that you should let the market rip, that you should let the unfettered market operate, in other words. So they're talking about introducing a price on carbon but they haven't yet done it, just as the US has been talking about introducing a price on carbon for the last decade and hasn't yet done it, at least at the national level.

It's interesting, though, the pressures that are causing change in China. You've got the issue that food and water required to keep Beijing and other cities running are considerable. And water access in many northern cities, especially in summer, is very precarious. As climate change shifts the rain bands, the big cities are becoming even more vulnerable. Similarly, access to clean air has become a big issue in China. One estimate is that about half a billion northern Chinese

people lose around 5 years of life expectancy due to air pollution, largely caused by coal burning which also, of course, contributes to climate change.

Meanwhile, the local manifestations of concern about environmental destruction in China, which has been proceeding at a record pace in some areas, are now starting to be a concern of Chinese authorities. Local communities have probably been articulating concerns about air pollution and water pollution for at least 20 years. But they're really bubbling up now that people have a bit more freedom.

In China, partly because of increased droughts in North China, they're really thinking about climate change. So far, China has been increasing its carbon emissions at a record pace, but they're also starting to move rapidly towards more renewable energy generation. By 2050, they could be up to 30% or so renewable. But, as in the rest of the world, so far, it's too slow, and Chinese carbon emissions are now 50% above America's carbon emission, overall.

AHC — They're still lower per capita, though, right ?

RC — Yes, Chinese carbon emissions are on average 5 to 6 tonnes per capita compared with about 16 to 19 tonnes, just counting CO_2 and not other greenhouse gases, per capita in the US, Canada and Australia, and about 8 tonnes in New Zealand. That is a fact probably not known to many Americans, who may think of China as just as responsible as the US for emissions. So, you know, although China's total carbon emissions are very high and growing very rapidly, per person they are quite low, but because they're such a huge population, 6 tonnes times 1.4 billion people is a great deal of carbon going into the atmosphere every year. The concern of many around the world is the rapid growth in emissions from China.

AHC — But a lot of that is displaced production from the West, right?

RC — That's right. What the Chinese economy is partly doing is producing consumer goods for the west and pro-

ducing emissions in the process. And that I think is very relevant to the problem of distance. There has been a lot of working trying to estimate the distant element of the footprint of the American or Canadian or European consumer, and it turns out that a significant part of China's emissions, one estimate is around 28 percent, is dedicated to keeping consumption going in countries outside China. If you really estimated the footprint in terms of consumption, not production- in other words, if you said what's the real footprint of someone in the US, you would actually add about 20%, or something of that order.

There's a significantly greater footprint of rich consumers in the West because they're importing goods from the developing world. So the recent stabilisation of emissions in the rich countries is not as good as it looks. People are not unaware of that but they tend to conveniently forget it when it comes to political debates. But of course the Chinese are very aware of it, and so they're very concerned to point that out, when there's a debate about targets and time tables and reducing carbon emissions.

AHC — One of the US's biggest arguments for not doing anything about climate change is that China isn't doing anything, right?

RC — Exactly, which is not true, of course. China is probably putting as much effort into dealing with climate change as is the US, possibly more. China is expanding its renewable energy generation faster than the US, but at the same time, because China is industrialising, and moving people to the cities where they have a higher standard of living, their total carbon emissions as a country as a whole are expanding rapidly, whereas in the US they're stabilising, and now starting to fall, which is good. But they should be falling fast; the US should be cutting its emissions from 18 tonnes per capita towards 2 or even 1 tonne per capita, which is about the sustainable level of emissions globally. America has to go from 18 down to 2, whereas China, even if it grows from 6 to say 8 tonnes per capita before it starts reducing its own emissions, is much closer to that target level of 2 tonnes per capita.

And that's got to be done by 2050 at the very latest. We have at the maximum 40 years to do that.

The other requirement is that, globally, the total of all countries' emissions should peak no later than 2020, that is, in the coming 5 to 10 year period. If they don't peak, if they don't go over the top and start declining rapidly, then we'll be sure we're going to face a feature of three to four degrees of warming. Just to explain why 3 degrees is too much warming - you remember there is a 'guard rail' of 2 degrees warming that is widely talked about - 2 degrees represents a transition between dangerous and probably catastrophic warming... and three degrees is even more into the catastrophic zone. There's little doubt that by 3 degrees warming two major phenomena would be well under way: one is that the Greenland ice sheet would be melting, irreversibly; and it's also likely that by 3 degrees of warming the West Antarctic ice sheet would be melting or very close to melting irreversibly. That could all even happen, possibly, at 2 degrees of warming. The threshold for Greenland

could be passed at two degrees of average global warming, but certainly by 3 degrees warming we can be pretty confident that those two ice masses, Greenland and the West Antarctic, would be irreversibly melting. And to remind ourselves what that means, those two ice masses together contribute, fully melted, about 14 or more meters of sea level rise. It wouldn't happen all at once. It would happen over hundreds if not thousands of years, but it would be irreversible once the tipping points had been passed, and so every century we would be seeing the sea level rising inexorably and ominously, and we couldn't stop it.

So,for example, if you faced half a meter of sea level rise every century or so, you would essentially have to rebuild major parts of London and New York and other port cities every century, to a half meter higher point, or retreat the whole city to some land that was half a meter higher one century and then a meter higher the next century, and so on and so on. So that represents a profound problem for all those low-lying cities around the world – London, New York, Rotterdam, Shanghai

all port cities. They're usually low-lying and they're often on river deltas. Sometimes you get a nasty combination of vulnerability to flooding as the rivers flood from periodic storm events, and there is continuing sea level rise at the same time, so the sort of thing that New Orleans is subject to now would be happening to New York and other riverport cities in future years. Perhaps without the hurricanes.

> AHC — Can you go through how climate change is not just about warming, but warming creating more energy in the system?

RC — So climate change is a generic term that covers a multitude of phenomena; it encompasses several key things. First of all, it encompasses global warming, but secondly, climate change encompasses acidification and de-oxygenation of the oceans - what has been called warming up, turning sour, and losing breath. And it also encompasses destabilisation of atmospheric circulation, through things such as heating of most of the atmosphere, and changes

in patterns of circulation. So if you take the first thing, warming, climate change means there's more energy in the atmosphere, and that means that already over the last 50 years or so, the amount of moisture in the atmosphere has increased around 4 or 5%. The energy, as the warming increases, pulls moisture out of the oceans much more rapidly than it used to, and so a build-up of moisture in the atmosphere then dumps more violently in snow and rain. So more energy is driving atmospheric processes, and this is allowing it to dump in certain extreme rainfall events, in storms and hurricanes.

> AHC — This is a very basic question, but does the greenhouse effect stop the energy that comes in leaving the atmosphere? So is that what creates the warming?

RC — More or less, yes. The warming is created by the greenhouse gases forming an insulation layer around the Earth. Radiation comes in – sunlight, for example – penetrating though the sky and clouds, through the atmosphere, that warms the

Earth, and then the Earth emits infrared radiation from the surface, and that infrared radiation happens to be trapped by the greenhouse gases. So the greenhouse gases are in effect transparent to incoming radiation at high frequency, and then it traps the low-frequency infrared heat that comes off the Earth. It's a combination, it's just like a duvet, it traps that heat inside a blanket.

AHC — How long have people known about global warming?

RC — It's certainly been known since a British chap called Fourier did work in the nineteenth century. A Swedish chemist called Arrhenius did work at the end of the nineteenth century, about 1895, when he modelled doubling the amount of carbon dioxide in the Earth's atmosphere and said if we double it we expect the temperature will rise about 5 degrees Celsius. Now that turns out to be not too far off accurate. Scientists now looking at a doubling of CO_2 concentrations say the effect will probably be around 2 or 3 degrees, but it could conceivably be 5 or 6 degrees, which would be trul-

catastrophic. He predicted over a century ago, in other words, what warming would be.

> AHC — There's a memorial site in Elysian Park and it's to a petroleum industry pioneer who gifted trees to downtown Los Angeles for the beautification of the city, and I was just wondering if, in the 1950s when a lot of the fast infrastructure for road and transport was being built, if people had an awareness then of this problem?

RC — No, in the 1950s they definitely did not have an awareness. When I was going through engineering school in the early 1970s, about 1972, my quite forward-looking teacher, Dr Mike O'Sullivan, said that scientists pretty much understood the greenhouse effect and they were concerned with the long term implication of burning fossil fuels. That's when I was first made aware of it. About 1972, but that was very unusual for people then to be aware of that as an environmental risk. And by the 1980s many people had heard of it but it hadn't trans-

lated into public consciousness at all. So in 1988 the Intergovernmental Panel on Climate Change, the IPCC, was set up, where scientists said, good heavens, there's all this evidence now that global warming is starting to take off so we must do something about it. So they created the IPCC in 1988, against the pressure from governments, generally, because the scientists were so concerned about scientific evidence pointing to a real problem. And that year, 1988, was a starting point in awareness, because it was in that year that James Hansen testified before Congress and said, we've got a heat wave happening in the US, this is the beginning of global warming.

And governments around the world started to do something about it in 1988, and that's the year I started work on it in the UK. And Margaret Thatcher, who was actually trained as a chemist, was briefed by the Meterological Office in the UK, and she realised there was a real issue, so the UK started doing something about it in 1988 as well. They're really one of the most advanced countries on it: Scandinavia and the UK, and Germany. The US

reluctantly started getting drawn into the international discussions on it, and then by 1997 emerged the Kyoto Protocol, 9 years after the formation of the IPCC. The Kyoto Protocol was signed by many countries including the US, but then the US refused to ratify it, and refused to put it into effect, although the other rich countries did ratify and put it into effect. And it's been very successful in reducing emissions in the countries that did ratify it, despite the views being expressed by conservatives in the US. For example, the European Union's core 15 countries have by 2011 cut emissions by around 14%, on average, below 1990 levels.

> AHC — And why is that? Because there's penalties for emitting? Because there's negative incentives?

RC — There's certainly a realisation by the countries that ratified the Kyoto protocol that something had to be done and if they worked together they could significantly cut global carbon emissions. But the US took the view that it would adversely affect their economy so they didn't ratify the protocol, and that in par-

ticular was the view of George W Bush, who reneged in 2001 on his election pledge to do something about climate change.

> AHC — Why was the ratification so long after the drawing up of the actual agreement ? Because Clinton was in power in 1997 when the Kyoto Protocol was being drawn up...

RC — So yes, in 1997 when the Kyoto protocol was adopted by many countries including the US, Clinton and Gore were indeed in power. At that time there were reservations expressed about it, even in the US Senate, which in fact voted against adopting any treaty that would push the US into taking action unless countries such as China took action. This resolution passed in the Senate, despite what the administration wanted to do. Clinton and Gore realised it would be very, very difficult to get a bill through the Congress for any kind of action, so delayed pushing for a vote to force action. And that's the way it turned out, which is a direct result of business lobbying – the oil and gas and auto industries

and others, lobbying against any action in the US for at least a dozen years.

> AHC — And that delay period was built into the protocol? It gave countries time...?

RC — In these international instruments there's always a delay between the adoption of an instrument and its ratification. For example, the Kyoto Protocol was adopted in 1997; it takes a long time for countries to ratify it, and countries like Russia, for example, took until 2005 to ratify it. It takes a long time for legislation to be passed in each country to ratify it. The smaller the country, the more quickly they can go.

> AHC — The ratification is the putting into law of the treaty, in each country?

RC — More or less. There are actually three steps. The adoption of a treaty, the signing, and then the ratification. But the key thing is that ratification means that you've taken the key steps necessary in your own country's legislation so that

the treaty can be put into effect. In other words, it will have an impact. It will be legally binding. It is however possible even then for a country such as Canada to renege. So in 2011, Canada decided they were more interested in developing and selling oil from tar sands, so they did not want to meet the target they'd agreed to in 1997, and Premier Stephen Harper walked away from their commitment. That was the direct abrogation of a legal and moral commitment they'd made. And the only sanctions against that kind of immoral decision is international community pressure. So in practice they can't be stopped from doing it unless someone wants to apply crippling sanctions, or go to war with them.

> AHC — Why is the peak of emissions important? Does it take a while to get out of the habit, in effect?

RC — It's called 'peaking emissions' and it represents the fact that global emissions at the moment are still going up. World emissions are rising, still largely driven by increases in China and India. So at some point if the concentration of

greenhouse gases in the atmosphere is to be stabilised, then emissions have to fall to zero or close to zero. And that is complex and perhaps counter-intuitive. People don't generally understand that, but the problem is that carbon dioxide sits there in the atmosphere for a long time and the molecules only gradually precipitate out of the atmosphere.

> AHC — How long do they sit there for? Like a hundred years?

RC — Well, put it this way: if you emit a ton of carbon dioxide, in a thousand years about 19% of it (190kg) will still be there. So when you take a plane flight from the US to New Zealand and back and produce, say, 5 tonnes of CO_2 and put that into the atmosphere, 19% of that amount (about 1 tonne) will still be there in the atmosphere in a thousand years' time, and – on a shorter scale – about 30 percent in a hundred years' time. That means that people need to reduce their emissions to almost zero for the atmospheric concentrations of greenhouse gases to be stabilised, i.e., constant. And that's necessary for the forcing effect,

the climate forcing effect that greenhouse gases have, the warming impact, to be controlled. So we need to reduce the concentrations now because they've got too high. The first step I should say is to reduce emissions to close to zero, so the concentrations don't increase anymore. And then we can start to act to reduce those concentrations a little bit.

To give you a sense of it, concentrations are about 400 parts per million at the moment, and they should really be somewhere around 350 parts per million. That latter estimate is based on Jim Hansen's work and that of other cautious climate scientists who can't be sure exactly what the safe level of concentrations is in the atmosphere, but they think it is likely to be around about 350 parts per million, plus or minus. The last time we were at 400 ppm was probably in the Pliocene, about 3 to 5 million years ago, when temperatures were 2 or 3 degrees higher than they are today.

AHC — And is it true that, because of that delayed effect, the warming we're experiencing at the moment

is in part or is entirely the emissions build-up from the Industrial Revolution to the present?

RC — Emissions have been building up in the atmosphere from really about 1800, and the temperature increase we've suffered, and the temperature increase we've noticed since then, is about 1 degree Celsius. So what's been happening in that period of 200 years essentially is that as the coal and oil and gas have been burnt, carbon dioxide has been building up in the atmosphere. Some of it has been precipitating out in various ways. Some of it has been absorbed by forests, some of it has been absorbed into the oceans. But our rate of emissions has risen steeply. So if, for example, we had stopped putting atmospheric carbon up there, if we'd stopped burning oil and putting it into the atmosphere back in 1990, we wouldn't have had nearly as much of a problem, because the concentrations would have been much lower and would have eventually started to drift down.

AHC — So that first hundred years

wasn't a problem?

RC — No, that first hundred or so years wasn't really a problem. It wasn't really a problem till about 1950. But post-war, the international economy expanded extremely quickly. So within my lifetime, since about 1950, the international economy has grown and grown and grown, and carbon dioxide. So essentially within one lifetime, one human lifetime, we've created this almost irreversible problem. Imagine, by the way, how sick that makes me feel about what our generation has done, and – for the last two decades – has done knowingly.

Even now, it would be manageable if we stopped emitting immediately. But concentrations have gone from somewhere a little above 300 parts per million in 1950, to now somewhere around 400 parts per million. That's a dramatic increase, and we've got to make sure that those concentrations don't go any higher, and preferably they would drop to about 350 parts per million – but that sadly is likely to take a while. So those are the big numbers, but the main

point is that global emissions simply cannot keep being allowed to grow if we want climate stability. If they grow any more in the next couple of years, then they have to peak immediately thereafter and then start falling very rapidly. Some scientists say they should be falling at around 5 to 10% per year, which is precipitous, in order to avert irreversible climate change; others say a bit more slowly, maybe 1 to 3% per year. But even that is very fast, when you think about how hard it is to trim something every year by 2 or 3%, year after year.

> AHC — So our time of useful consciousness is maybe two years?

RC — Our what?

> AHC — So our time of useful consciousness, it's two years?

RC — So yes, our time of useful consciousness can be interpreted in this context as meaning we know now that we've got into a very dangerous situation, we've got a limited time to get out of it before essentially it's too late, before

we cross a tipping point. That may be a socio-political tipping point as much as a physical tipping point. We don't know quite when that physical tipping point is going to be but there are some very ominous, worrying signals that it could be very soon, and on any account it means that we've got to reduce our emissions by enough to be close to zero emissions by 2050. And to do that without destroying our economies and destabilising our societies means that we have to start extremely soon. And even the International Energy Agency, which is quite a conservative organization, points out that we have to do it extremely rapidly and that every year of delay could cost trillions of dollars, because what we're essentially doing as we delay is that we invest in more and more industrial plants and highways and fossil fuel power stations, more infrastructure that commits us to future carbon emissions. If we're prepared to write that off, that's fine, but there is a big cost to writing off capital that we've just invested in, and most people don't want to do it. So essentially they are saying, at the International Energy

Agency, that by no later than 2017 all our new infrastructure should be zero carbon infrastructure. So within 5 years' time we should only be building infrastructure that is zero carbon infrastructure. So a pretty conservative, careful organization like the International Energy Agency is saying that we have a very, very short time left, 5 to 10 years, before we have to be moving rapidly to operate on a zero-carbon basis.

> AHC — But does that mean not building any more power plants or does that mean not using any of the power plants built?

RC — That means – to take power plants – building no more carbon-producing, no more coal-fired, no more gas-powered plants, unless we can be sure that we have carbon capture and storage technology working, and as yet there is no commercially viable carbon capture and storage technology. That's called CCS (carbon capture and storage), and it's a possibility that we could develop that technology a long way in the next 20 or so years, but we certainly don't have it working yet.

AHC — But we do have enough renewable energy sources like wind and solar working?

RC — That's right. The obvious thing to do is to invest dramatically fast in renewable energy. Wind in particular, on-shore and off-shore wind, is commercially viable in most countries at this point. So that's the most sensible thing to do. But solar PV – solar cells on roofs and walls – are close to commercial in many countries, and in some places in the southwest of the United States and Australia they're commercially viable already at this point because the amounts of solar radiation in those areas is so great. So solar power is certainly viable in parts of the world, and PV arrays are quite widespread now in Germany and Japan and China and the southwest of the US, so that sort of investment is very worthwhile. As it spreads, costs will continue to fall rapidly and there will be a huge further spread of solar power.

I'm just thinking back to the Bill McKibben quote about if we ourselves are the enemy or if oil companies are the enemy.

My view is that it's too simple to say that the oil companies are the enemy, because the enemy is really ourselves - we consume the products of the oil companies.

You've got to look at the final demand for oil and gas and coal, and it's you and I who burn the petrol in the cars that we drive around, and the planes we use, so we've got to change our demand-side behavior. It does help, though, if the oil companies reduce their wasteful exploration. Don't forgot that Exxon is planning to put a hundred million dollars a day into looking for oil and gas, oil and gas we can't afford to burn. That is completely wasted investment. It would be much better if they were pumping a hundred million dollars a day into renewable energy.

> AHC — But we would use energy if it was solar and wind energy - we would be using it at the same rate and in the same way? It's not that people wouldn't rather be using renewable energy?

RC — People generally want to use renewable energy, I agree, but the problem in general is that there is not yet enough of it to supply everybody's needs in most countries. Iceland and New Zealand, for example, are largely renewable energy countries, but are the exception. The sources of supply have not been developed sufficiently, so that people can't just use renewable energy, so they are forced to use, for example, petrol in cars. If the technology was there they would be using electric vehicles which ran off renewable electricity generation.

> AHC — It requires consumer pressure on the energy producers to become more renewable as well? But isn't consumer pressure a small tool against the lobbying pressure of energy companies?

RC — Yes, any individual or small group of individuals on the consumer side has almost no influence alongside the impact of Exxon or the other big energy companies. But if there was a mass movement in which consumers were prepared not to buy fossil energy to drive their cars – fossil fuels, like oil - then things would

change. Because that would start to impact on the energy companies' bottom line, on the profit of these big energy companies, they would start to change their habits. And people could be withdrawing their investments from the big oil and gas companies until they go renewable.

> AHC — It requires a consumer boycott essentially of the fossil fuel companies. Do you think that's more effective than political action, than voting into power...

RC — Yes, a boycott is an essential part of a mass movement, as well as political action. If you vote someone into power, they will say, 'What's the alternative? We will increase the amount of renewables a bit but we can't supply American energy needs entirely from renewables, we have to have fossil fuel based energy.' So there needs to be a way to bring consumer pressure onto the fossil fuel companies in various creative ways, and there needs to be voting pressure on the politicians as well to accelerate renewables. And those two things have

to come together rapidly in a pincer moment, so there is both demand side pressure from consumers and there is political pressure on the big suppliers, to reduce the supply of fossil fuels and offer renewable, green energy alternatives. Using buses and bicycles and walking and minimising car use is all part of that consumer picture.

So it's not easy, but it has to be partly demand pressure from people consuming less, because otherwise politicians will say to people, 'you are hypocrites, you want the fossil fuel companies to reduce their production but you want to keep on buying petrol just as before'. People have got to cut their fuel use. People have to reduce their fossil fuel demand at the same time as they pressure government to be more astute about promoting the alternative energy supply system.

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